Kinetics of CH_4 oxidation in mixed culture

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ABSTRACT

Methane is known as a 'greenhouse' gas and produced in large quantities from a wide range of sources such as swamps, marshes, and paddy fields. Municipal solid waste landfill sites are one of the methane production sources. The main paths of methane emission from a landfill site are cover soils and gas venting pipes. A lot of research on the potential of cover soils to oxidize methane has been reported. Another place where methane can be oxidized is gas-venting pipes. To design a device for methane oxidation in gas venting pipes by aerobic microorganisms, it is necessary to clarify the CH_4 oxidation rate at various CH_4 and O_2 concentrations.

Although many researches on kinetics of CH_4 oxidation were reported, the effect of O_2 concentration was scarcely discussed. The purpose of this paper is to determine the kinetics of CH_4 oxidation and included parameters at various CH_4 and O_2 concentrations.

Cultures used for CH_4 oxidation experiments were prepared by enrichment of extract from a digested sewage sludge, park soil, or leachate from two landfill sites under 20 % of CH_4, but not isolated. Therefore, the cultures were the mixture of CH_4 oxidizing and other aerobic microorganisms. The CH_4 oxidation experiments were conducted with a batch reactor in which the change in gas volume can be measured. The mixture of air and CH_4 was introduced; initial CH_4 concentrations were ranged from 5 % to 20 %.

CH_4 oxidation was expressed as a Monod equation for CH_4 and first order reaction for O_2. A determined half saturated constant (K_m) was 7.5×10^{-5}-7.1×10^{-4} (mol/L), and a maximum oxidation rate (V_{max}) was 3.8×10^{-14}-3.9×10^{-11} (mol/hr/cell). The mole ratio of consumed O_2 to CH_4 was 1.6-1.8.